

terests were given ample warning that this storm would be unusually severe. On the north Pacific coast the most important storm of the month occurred on the 14th and 15th. The principal storm of the month in the Atlantic States occurred on the middle Atlantic and south New England coasts on the 24th.

The display of wind signals was discontinued for the season on Lake Pepin, November 30; on Lake Michigan, December 10; on Lake Huron, December 12; on Lakes St. Clair, Erie, and Ontario, December 15; and on December 17, the date of the closing of the locks, at Sault Ste. Marie, Mich.

Referring to the movements of vessels on the Great Lakes during the close of the season of 1899, Mr. Harvey C. Beeson, publisher of Beeson's Marine Directory, remarks in the Milwaukee Sentinel of December 21, 1899, as follows:

A number of vessels have been making trips, with comparatively little danger, in the past few weeks, without insurance. They have relied a great deal upon the weather forecasts in determining their action; and I want to say here that the value of our Weather Bureau service has never been so signally shown as it has this season.

#### CHICAGO FORECAST DISTRICT.

Up to the time of closing of navigation warnings were issued for storms which occurred on the upper Lakes on the 1st, 5th, 11th to 13th, and 24th and 25th. The storm of the 11-13th was particularly severe, and special forecasts and warnings regarding its progress and character were issued as follows: Storm signals were ordered 9:45 a. m., 11th, for Lakes Huron and Superior. On Lake Michigan warnings were sent to open ports, the display of signals for the season having terminated. All upper Lake stations were advised to hold vessels in port, as a severe storm was central over Illinois and moving northeastward, which would cause dangerous easterly shifting to northerly gales, with rain turning to snow and much colder weather. At 9:15 p. m. of the 11th the following message was sent to all observers:

Storm central over northern Illinois, increasing in intensity. Dangerous gales indicated. Colder and snow. Continue to hold vessels in port.

At 9:45 a. m., December 12, the signals on Lake Superior were changed to storm northwest, and the following message was sent to all upper Lake stations:

Dangerous northwest gales, diminishing Wednesday. Snow and colder.

During the gale the steamer *Arthur Orr* went ashore on Lake Huron at Cove Island. She was badly damaged, but later released. The whaleback barge No. 115, which was in tow of the steamer *Colgate Hoyt*, broke away off the Portage Canal and foundered on the north shore of Lake Superior. Ample warning that the storm would be unusually severe was given, and all vessel masters had an opportunity to seek shelter.

Ample and detailed warnings were given of the cold weather which overspread the Western States on the 3d and 4th and 24th and 25th.—*H. J. Cox, Professor.*

#### SAN FRANCISCO FORECAST DISTRICT.

On the morning of the 6th conditions were such as to warrant a forecast of light to heavy frost in citrus fruit belt; temperatures below freezing were reported on the morning of 7th.

Southeast storm signals were displayed along the north coast on the 7th and justified. On the 9th citrus fruit growers were again warned that conditions were favorable for heavy frosts Sunday morning. Minimum temperatures of 29° and 30° were reported on the mornings of the 10th, 11th, and 12th. On the 13th it was stated that conditions were favorable for the heaviest frost of the season to date, and it may be noted that in the center of the orange belt the lowest minimum temperature, 28°, which occurred during the month of December was reported.

From December 19 to 29 an area of high pressure covered the country between the Sierras and the Rocky Mountains. Connected with this pressure distribution was the prevalence of tule fog in the great valleys of California. For about ten days in the San Joaquin Valley, in the Sacramento Valley, and also in the other valleys of California peculiar temperature inversions were reported. The cold air from the northeast was evidently slowly drained into the valleys and, owing to the absence of wind, gradually settled to the low lands. This ground or tule fog was so dense as to seriously inconvenience farming operations. Day after day the morning and evening temperatures would remain at about 36°, the amplitude of the diurnal curve, which is generally about 10°, ranging from 40° to 50°, ranging from about 36° to 38°. The persistence of this condition is noteworthy, and also the fact that the breaking up of this condition was accurately forecast on the morning of the 29th. On the 29th the approach of an extensive storm of considerable energy was forecast, and southeast storm signals were displayed from San Francisco to Eureka.—*A. G. McAdie, Forecast Official.*

#### PORTLAND, OREG., FORECAST DISTRICT.

The river forecasts issued during the month were of much interest and value.

On the 14th the outlook was such that a special warning to stockmen was included in the forecasts for Idaho, and Oregon and Washington east of the Cascades. It was stated that severe weather of four to six days' duration was indicated for the country east of the Cascades. Although the fall in temperature was not as great as was anticipated, yet there ensued six days of cold weather—the coldest yet this season—during which a temperature of 10° occurred at Spokane, 8° at Walla Walla, 6° at Baker City, and zero at Kalispell.—*G. N. Salisbury, Section Director.*

No special warnings were issued for the Havana forecast district.

#### AREAS OF HIGH AND LOW PRESSURE.

During the month there were nine highs and fifteen lows which were sufficiently well defined to admit of being charted. See Charts I and II.

The following table gives the principal facts regarding the place of origin and disappearance of these highs and lows, together with other pertinent data. Some descriptive data is also added.

*Highs.*—The three highs which were first noted on the Pacific coast. Nos. I, III, and V, disappeared in the central Rocky Mountain region. Of the three which first came within the field of observation in the British Northwest Territory, two, Nos. II and IX, moved southeastward to the south Atlantic coast, while the other, No. VI, moved eastward, disappearing toward Hudson Bay. No. VIII originated in southeastern Colorado, moved eastward to northern Maryland, and thence northeastward to Nova Scotia. Nos. IV and VII were of minor importance.

A high of considerable magnitude remained practically stationary in the British Northwest Territory from the morning of the 14th to the evening of the 16th, reaching its crest on the morning of the 15th. On the 18th the characteristic winter type of high peculiar to the northern and middle Plateau, appeared over those districts, and still persisted at the close of the month, but with much diminished intensity and many indications of early dissipation.

*Lows.*—Four of the fifteen lows, Nos. III, V, VIII, and X,